SI1140 Mathematical Methods in Physics 9.0 credits

Fysikens matematiska metoder

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for SI1140 valid from Autumn 2015

Grading scale

A, B, C, D, E, FX, F

Education cycle

First cycle

Main field of study

Physics, Technology

Specific prerequisites

Recommended prerequisites: In order to assimilate the course material, it is recommended that the students have taken the following courses or have acquired the corresponding knowledge in a different manner:

- SF1602
- SF1603
- SF1604

For part 2, the course SF1629 is also recommended.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completing the course, a student should be able to
Part 1 (TENA):

- Use vector analysis to describe and analyse physical systems
- Model and formulate basic problems in physics within, e.g., electromagnetism and fluid mechanics, using vector analysis
- Describe different physical situations where singular vector fields appear and use these to describe physical systems
- Apply tensor analysis on basic problems in physics within, e.g., solid mechanics
- Use symmetries and basic group theory to draw conclusions regarding physical systems

Part 2 (TENB+INLA):

- Formulate problems in terms of partial differential equations starting from basic physical questions
- Numerically model and solve physical problems described by partial differential equations
- Use expansion in eigenfunctions as a tool for solving problems that appear in, e.g., quantum mechanics and electromagnetism
- Define and in basic cases apply Green's functions to physical problems, e.g., diffusion and wave propagation
- Analyse physical problems using variational principles and energy arguments

Course contents

Vector analysis (Part 1):

Concepts within vector analysis and their physical applications: the nabla operator, integral theorems, and potential theory. Tensors with applications from, e.g., electrodynamics and continuum mechanics. Special vector fields and their importance within physical modelling. Modelling using vector analysis. Symmetry concepts with relation to basic group theory and their significance in physics.

Partial differential equations (Part 2):

Physical problems leading to different types of differential equations, e.g., the wave equation, Laplace' equation, and Poisson's equation. Numerical solutions to physical problems. Separation of variables in cartesian, cylinder, and spherical coordinates, resulting in special functions, e.g., Bessel functions, Legendre polynomials, and spherical harmonics. Basic theory and application of Green's functions in physics. Variational calculus and physical

modelling using energy principles. Relation between analytical methods and finite difference/element methods.

Course literature

The course literature is decided by the Department of Theoretical Physics and announced through the course homepage at least four weeks before the start of each part.

Examination

- INLA - Handin Assignment Part 2, 1.0 credits, grading scale: P, F
- TENB - Written Examination Part 2, 4.0 credits, grading scale: A, B, C, D, E, FX, F
- TENA - Written Examination Part 1, 4.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Other requirements for final grade

At least grade E in both exams (TENA and TENB) as well as passing the hand in assignment (INLA). The exams should normally be written exams.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.